

NOVEMBER 2024



INFOFLASH



**SECURING THE SKY: CHALLENGES TO
BUILDING A EUROPEAN INTEGRATED
AIR AND MISSILE DEFENCE SYSTEM**

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Introduction

The European airspace is deeply vulnerable in the face of unprecedented threats emerging from state adversaries and increasingly disruptive technologies. Recent events underscore the urgency of addressing these vulnerabilities. In 2022, Russia began its war of aggression in Ukraine, whereby the use of Kinzhal hypersonic missiles, Shahed drones and electronic warfare (EW) have since repeatedly caused mass damage to Ukrainian air defences and critical infrastructure. This barrage of weapons systems not only demonstrates the destructive potential of modern air attacks but has more importantly exposed significant pervasive capability gaps in European air defence systems. Indeed, despite these escalating threats, Europe's air defence capabilities remain fragmented and underdeveloped, even as novel initiatives such as the ESSI begin to emerge to fill gaps in European air capabilities. This paper addresses the state of European air defence in two ways. First, it examines the value of IADS as a crucial conceptual framework for discussing European air defence. Second, it argues that there are several political, military and economic challenges that emerging initiatives such as the ESSI face in promoting a European IADS that need to be overcome if Europe is to be able to effectively and credibly protect its own airspace.

1. Conceptualising Integrated Air and Missile Defence

Emerging technological threats in the airspace

The technological demands for European air defence are increasing substantially. As Russia's war of aggression in Ukraine highlights, the performance of missiles, unmanned aerial systems (UAS), hypersonic missiles and supporting EW tactics have advanced considerably (Wachs, 2023). For instance, analysts who advocate for the revolutionary effects of UAS argue that drones, with their low-altitude flight, low cost, small size and lethality, are transforming the conduct of warfare (Hambling, 2020). By penetrating enemy airspace and improving the probability of arrival (PA) of air power, drones - when paired with EW capabilities - are argued to be shifting the balance of power in favour of offence rather than defence. In this scenario, air defences are structurally vulnerable and at a disadvantage. While these claims may be overstated (Calcara et al., 2022), actors that fail to implement the necessary air defence technologies, techniques and procedures to counter unmanned aerial vehicle (UAV), EW and hypersonic missile threats will struggle to safeguard their airspace.

Technological developments are, therefore, exacerbating the complexities of already demanding integrated air defence systems, which require sophisticated coordination between multiple components, including sensors, radars, shooting platforms and command and control (C2) units (Calcara et al., 2022). To counter these threats, the integration and

development of a multi-layered European air defence system is crucial. Situating initiatives like the ESSI within the broader goals of creating a European air defence shield requires an understanding of the structure and operations of these integrated systems. This is crucial, as policymakers and political observers often misuse references to IADS, lacking a deep understanding of their true scope (Peter & Mattes, 2019, p. 1).

Defining IADS

Peter and Mattes (2019, p. 3) define an IADS as the "organised amalgamation" of structures, equipment, personnel, procedures and weapons used to defend against airborne penetration of claimed territory. They argue that IADS systems perform three primary functions: air surveillance, battle management and weapons control.

Air surveillance serves as the system's eyes, continuously detecting, tracking and identifying airborne threats. Modern air defence technology automates many surveillance tasks, using computers to track objects from radar data streams and even identify whether they are hostile or friendly, making this function more efficient (Heileday, 1988). To counter evolving EW threats like those posed by Russia over Ukraine, modern radars must incorporate advanced electronic counter-countermeasures (ECCMs), such as frequency hopping and agile waveforms (JAPCC, 2023). These technologies allow radars to detect threats while avoiding detection themselves, reducing vulnerability to jamming and deception (Pace, 2012). Systems like the Buk-M and AN/MPQ-64 Sentinel, used by Ukrainian forces, exemplify this approach (Deagel, 2024; Militarnyi, 2024).

Battle management is the intermediary stage between threat identification and response, where raw data is transformed into decisions for weapons engagement. This stage requires radar networks to work with C2 nodes to evaluate whether a tracked object poses a threat, select the appropriate weapons system and confirm engagement. Simultaneously, C2 staff develop and diffuse a common air picture, which provides a common threat evaluation for air defenders across the air defence system (Shaikh, 2024).

Weapons control is where engagement takes place, pairing the chosen weapon system with the target for acquisition, tracking, guidance and neutralisation. Hostile targets are neutralised using systems like airborne interceptors, surface-to-air missiles (SAMs) or anti-aircraft artillery.

Integration

This formulation of air defence departs from the traditional texts by authors such as Heildenday (2000) by introducing the notion of integration, which focuses on the interrelation of the various functions of an air defence system. A common analytical error is the overemphasis on specific components, such as SAM systems, while neglecting the broader integrated system. SAMs, like the S-400, are sometimes mischaracterised as standalone IADS, but they are only one component of a larger, interconnected system that includes detection, battle management and weapons control. A fully integrated IADS system ensures these functions operate simultaneously across multiple levels, enhancing resilience against threats such as missile strikes, drone swarms and EW. By leveraging modern communication technologies—such as satellite communications, 4G networks, WIFI, data links and cloud computing—a layered, integrated system can maintain functionality even if one element is compromised (JAPCC, 2023).

The value of IADS

The value of IADS is twofold. First, in peacetime, IADS serves as a powerful deterrent. A multi-layered air defence system increases uncertainty for potential attackers, raising the threshold for a conventional strike by forcing them to commit to larger, more costly operations with higher risks of escalation (Wachs, 2023). Second, in times of conflict, IADS protects critical military and political assets—such as airbases and government institutions—from a wide range of threats, ensuring the defender's freedom of action. This diminishes the opponent's coercive power while strengthening European defence cohesion and political stability.

2. The State of European IADS

Russia's repeated airspace violations over the past few months using drones, particularly in Latvia and Romania, have drawn increased attention to the state of European IADS and its ability to counter more serious incursions (Stanley-Smith, 2024). In fact, initial assessments of European air defence capabilities were made after Russia's annexation of Crimea, notably during the 2016 NATO Warsaw Summit (NATO, 2016). Problematically, these evaluations revealed that no non-U.S. NATO member had a fully integrated, multi-layered air and missile defence system and thus emphasised the need to further invest in and develop NATO's Ballistic Missile Defence program. At the EU level, IADS has likewise become a core part of the EU Capability Development Priorities. Its importance was further demonstrated within the European Defence Industrial Strategy (EDIS), which identified significant funding needs

for various systems tied to the three core IADS functions (European Defence Agency, 2023; European Commission, 2024).

However, initiatives following these assessments have been largely fragmented, characterised as "piecemeal" and "unsustainable" (Monaghan & Christianson, 2023, p. 3). This stems from Europe's traditional emphasis on air superiority for air denial, a legacy of the Cold War. Coupled with the subsequent shift towards counterterrorism and counterinsurgency (COIN) operations in the early 21st century, European air defence capabilities have significantly deteriorated over the past fifty years (Tong, 2020). As a result, several reports, including those from the Center for Strategic and International Security (CSIS) (Monaghan & Christianson, 2023), the German Institute for International and Security Affairs (SWP) (Walch, 2023), and Breugel (Steinbach & Wolff, 2024), warn that European air defence is lagging, unable to counter emerging threats like hypersonic missiles, anti-ship missiles and UAS which Russia has deployed against Ukraine. With NATO's eastern flank receiving only about 5% of the air defences needed to guard against a full-scale attack (Foy & Rathbone, 2024) and 18 of 38 European nations analysed by CSIS in 2023 to be lacking sufficient air defence systems or planned acquisitions, significant hurdles remain for European air defence (Monaghan & Christianson, 2023).

Despite these shortcomings, there has been a strong political push to strengthen European air defence, especially following Russia's invasion of Ukraine. NATO has taken a leading role in this effort by strengthening its IADS framework, primarily providing C2 support and early warning systems. These functions are crucial for connecting NATO members' missile defence assets in Europe, including the U.S.' Aegis, Patriot systems and regional radar networks, which are coordinated from Ramstein Air Base in Germany (Muravska, 2023). However, NATO's C2 framework alone cannot fully safeguard Europe's critical infrastructure and must be supplemented by European-wide efforts, especially to address gaps in mobile systems and lower-tier interceptors that can protect against diverse threats. As the most notable of these efforts has been the ESSI, discussions of the continuing challenges facing European air defence can be understood through its inherent limitations and the obstacles that it has and continues to face.

European Sky Shield Initiative

The ESSI marks a critical juncture in the trajectory of European air defence, which, while deployable within the NATO framework, seeks to bolster its European pillar, therefore strengthening European strategic autonomy as a whole. The initiative is considered the "brainchild" of Scholz (Monaghan & Christianson, 2023, p. 1) and is often understood as a crucial step in Germany's operationalisation of its *Zeitenwende*. During the presentation of

the initiative, Scholz described it as a "jointly developed air defence system in Europe" that aims to be "more efficient and cost-effective" than the previously fragmented approaches (Monaghan & Christianson, 2023, p. 10). Since its launch in 2022, it has amassed 22 member states, with Türkiye, Poland and Greece joining in 2024 (Desmarais, 2024).

More precisely, the ESSI seeks to bolster air and missile defence principally through the joint acquisition of air defence equipment, ammunition stockpiles and missiles among European nations, ensuring that members develop ground-based air defence systems made up of integrated C2 assets, interoperable sensors and weapons systems to create a defensive shield (Wachs, 2023, p. 4). To address capability gaps, the ESSI focuses on several key areas. First, for very short-range air defence (VSHORAD)—identified in the 2022 Defence Investment Gaps Analysis (European Commission, 2022) as an air defence priority—the initiative aims to replace outdated systems like the Ozelot with modern close air defence systems, such as the LVS NNbS, to protect ground forces from threats posed by helicopters and UAS. For short- to medium-range air defence, the ESSI plans to procure the IRIS-T SLM system, enhancing the ability to counter various aerial threats, including cruise missiles (Defense News Army, 2024). In terms of long-range air defence, the priority will be acquiring new Patriot systems and replenishing existing ammunition stocks, enabling the interception of a wide range of threats from large UAS to short-range ballistic missiles. Lastly, and controversially, the initiative also plans to procure the Arrow 3 system, which is designed to target medium- and intermediate-range ballistic missiles primarily outside the atmosphere (Desmarais, 2024). Alongside such weapon engagement systems, companies like Hensoldt will supply radar technologies to improve the integration of disparate systems.

The promise of the ESSI

Politically, the ESSI has the potential to foster trust among its 22 members by promoting solidarity and cohesion through joint procurement of critical multi-layer air defence systems (Adamowski, 2024). This institutionalised cooperation could prove vital for developing a shared strategic culture, particularly through references to the joint protection of participating members, including traditionally neutral states such as Switzerland, which signed a declaration of accession on October 18, 2024 (Swiss Federal Council, 2024). Furthermore, by emphasising burden-sharing and cooperation, the initiative enhances Europe's credibility as a responsible and reliable security actor capable of safeguarding the 'public good' of airspace (Steibach & Wolff, 2024). Simultaneously, reliance on the U.S. for European air defence will decrease, insulating Europe from the inevitable shift in U.S. priorities (Monaghan & Christianson, 2023, p. 14).

Economically, the ESSI offers significant potential by promoting defence procurement across

multiple European nations, resulting in cost savings through economies of scale, as demonstrated by the recent procurement of approximately 1,000 Patriot systems (Janowski, 2024). These large-scale initiatives reduce duplication of development efforts and foster competition within the air defence industry. By supporting the development of European production facilities for systems like the IRIS-T, the ESSI strengthens the continent's defence supply chains and bolsters its industrial base (Steinbach & Wolff, 2024).

3. Challenges to a European IADS

Nevertheless, while a step in the right direction, the ESSI is ultimately limited by political, financial and military-based factors, which are representative of the overall challenges facing the state of European air defence.

Political challenges

The ESSI focuses on a limited selection of mostly off-the-shelf systems, some of which are non-European, making the initiative unattractive to certain European states. Notably, voices from France and Italy argue that the ESSI poses an obstacle to European strategic autonomy (Kayali, 2024). This perspective rests on two main arguments. First, Berlin's decision to acquire the Israeli-U.S. Arrow system is deemed misplaced and irresponsible (Challenges, 2023). Critics contend that procuring these expensive, non-European systems lacks strategic justification, as they do not address key European capability gaps identified in the NATO Defence Planning Process (NDPP) and primarily serve German political interests (Wachs, 2023; The Economist, 2024). This poses a challenge for Alliance states prioritising NDPP goals, as the ESSI's failure to do so could complicate European and NATO air defence policy, weakening deterrent effects and undermining European collaboration.

Second, by focusing on a limited selection of ground-based air defence systems, many of which are non-European, the ESSI fails to stimulate investment in European capabilities and undermines efforts to strengthen Europe's military-industrial capacity. During the conceptual phase, France and Italy proposed prioritising the Franco-Italian co-developed Sol-Air Moyenne Portée/Terrestre (SAMP/T) system, a competitor to the U.S.-based Patriot system (Defense News Army, 2024a). When this proposal was rejected in favour of the U.S. system for medium-range air defence, both countries opted out of the Sky Shield Initiative. In response, France has gained support from Estonia, Hungary, Cyprus and Belgium to jointly purchase the French Mistral system for short-range air defence, providing an alternative to U.S.-dominated systems (Fiorenza, 2024). Consequently, friction is emerging in Europe over the frameworks and interoperable systems needed to develop and operationalise a European-wide IADS system.

In recent months, proposals have emerged alongside the German-led, NATO-linked ESSI project, including a letter from Tusk and Mitsotakis to the European Commission on 23 May 2024, advocating for a "European air defence shield" in response to rising security threats, particularly Russian aggression in Ukraine (Mitsotakis & Tusk, 2024, p.2). They emphasise the need for a 'common EU airspace' to safeguard Europe, a proposal supported by European Commission President Ursula von der Leyen and Josep Borrell (Boolen & Vela, 2024; Sprenger, 2024). Although this appeal was not discussed at the June 2024 Council meeting and no further public action has occurred, it shows that key ESSI members—Poland and Greece—do not see the initiative as a suitable platform for developing an operational IADS.

The core issue is clear: state centrism still influences European perspectives on air defence, with financing domestic air defence seen as more acceptable than funding broader European initiatives. Exemplified by parallel German and French-led efforts, European states coordinate various aspects of air defence in an ad hoc, federated manner, prioritising domestic economic and political interests over allied cooperation and interoperability.

Military/technological challenges

While the ESSI has several stated, ambitious goals, including the development of common, interoperable and even integrated systems and networks, there is much ambiguity over how it would achieve this (Monaghan & Christianson, 2023). Indeed, Mareen and Stock (2024, para. 6) emphasise that "Sky Shield currently lacks a concept of operations, information-sharing networks, and interoperability exercises required to make the idea a reality." This means that it lacks the means to integrate effectively into the NATO structure, including the NATO Integrated Air and Missile Defence System (NATINAMDS) and NATO's Air C2 System. For example, it is unclear how systems such as the Arrow 3 will be interoperable with broader integrated networks and European battle management systems.

To mitigate these challenges, initiatives like PESCO's Innovative Air and Missile Defence (IMLAMD) could prove beneficial. IMLAMD focuses on developing innovative concepts for future air and missile defence systems, including the creation of a Battle Management, Command, Control, Communication, Computer and Intelligence (BMC4I) module, which could be implemented at the EU level to complement NATO's C2 structures (Defence Industry Europe, 2023).

Financial/industrial challenges

Furthermore, providing multi-layered integrated air defence is expensive and is a crucial cause of European underinvestment in costly systems such as the IRIS-T or the Patriot – with

one battery for the patriot system costing around one billion dollars (Nardelli et al., 2024). Given the little fiscal space available within regular European national budgets for funding air defence and that procurement and development of layered systems remain fragmented and inefficient, Europe must find a more sustainable means to finance a European air shield. Instead of focusing on off-the-shelf procurement, Europe should begin extensive funding into air defence research and development (R&D) projects able to intercept a wider array of threats. One avenue identified by Steinbach and Wolff (2024), could be to debt finance European air defence, whereby R&D for ESSI projects could be achieved through the PESCO framework.

Conclusion

This paper addressed a critical gap in European defence: the absence of a cohesive, integrated air defence system that can effectively counter emerging threats. In light of Russia's recent aggression and the accelerating pace of technological advancements in hypersonic missiles, drones, and electronic warfare, the paper argues that a unified European Air Defence Shield is not merely necessary but urgent. In the short term, Europe faces significant challenges in modernising outdated, fragmented air defence systems and establishing a fully integrated, multi-layered air and missile defence shield to counter Russia's precision-strike capabilities. The limitations of the ESSI highlight the critical need for a unified threat assessment to facilitate coordination in national and multinational procurement and development processes. Such coordination is vital for effective integration across key IADS functions: surveillance, battle management and weapons control. To enhance interoperability and strategic coherence, NATO and Berlin should convene ESSI members, promote a transparent evaluation of each member's defence priorities and capabilities and outline ongoing procurement and development initiatives. This alignment would help synchronise Europe's IADS functions, close gaps in surveillance, improve battle management coordination and optimise weapons control across national systems, paving the way for a more resilient and integrated European air defence network.

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